

## **SECTION 23 23 00**

### **REFRIGERANT PIPING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Refrigerant piping.
- B. Joining materials.
- C. Valves.
- D. Fittings.
- E. Strainer.
- F. Refrigerant driers.
- G. Moisture indicators.
- H. Sight glasses.
- I. Expansion valves.
- J. Hot gas bypass valves.
- K. Vibration eliminators.
- L. Refrigerant.

##### **1.02 RELATED SECTIONS**

- A. Refrigerant piping sleeves, hangers, and supports are specified in Section 20 20 13 - Pipe Sleeves, Supports, and Anchors for Facility Services.
- B. Pipe and valve identification is specified in Section 20 40 13 - Identification for Facility Services.
- C. Pipe insulation is specified in Section 20 07 13 - Plumbing and HVAC Insulation.

##### **1.03 MEASUREMENT AND PAYMENT**

- A. General: Refrigerant piping system will not be measured separately for payment but will be paid for as part of the Contract lump-sum price for Mechanical Work as indicated in the Bid Schedule of the Bid Form.

##### **1.04 REFERENCES**

- A. Air-Conditioning and Refrigeration Institute (ARI):

REFRIGERANT PIPING

1. ARI 495 Refrigerant Liquid Receivers
2. ARI 710 Liquid-Line Driers
3. ARI 730 Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers
4. ARI 750 Thermostatic Refrigerant Expansion Valves
5. ARI 760 Solenoid Valves for Use with Volatile Refrigerants

B. American National Standards Institute (ANSI):

1. ANSI B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
2. ANSI B16.26 Cast Copper Alloy Fitting for Flared Copper Tube
3. ANSI B31.5 Refrigeration Piping
4. ANSI B31.9 Building Service Piping

C. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):

1. ASHRAE 15 Safety Code for Mechanical Refrigeration
2. ASHRAE 34 Number Designation of Refrigerants

D. American Society of Mechanical Engineers (ASME):

1. ASME Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
2. ASME B31.9 Building Services Piping
3. ASME SEC 8D Boilers and Pressure Vessels Code, Rules for Construction of Pressure Vessels

E. American Society for Testing and Materials (ASTM):

1. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
3. ASTM B88 Seamless Copper Water Tube
4. ASTM B280 Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

- 5. ASTM F708 Design and Installation of Rigid Pipe Hangers
- F. American Welding Society (AWS):
  - 1. AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding
  - 2. AWS D1.1 Structural Welding Code, Steel
- G. Manufacturers Standardization Society (MSS):
  - 1. MSS SP58 Pipe Hangers and Supports – Materials, Design and Manufacturer
  - 2. MSS SP69 Pipe Hangers and Supports – Selection and Application
  - 3. MSS SP89 Pipe Hangers and Supports – Fabrication and Installation Practices
- H. Underwriters Laboratories Inc (UL):
  - 1. UL 429 Electrically Operated Valves

#### **1.05 REGULATORY REQUIREMENTS**

- A. Refer to Section 20 10 13 - Common Materials and Methods for Facility Services – Fire Suppression, Plumbing and HVAC.

#### **1.06 SUBMITTALS**

- A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Shop Drawings: Submit Shop Drawings including plans, elevations, and sections of piping layout, and locations of valves, strainers, and equipment to which piping system connects. Submit assembly, erection, and installation drawings.
- C. Product Data: Submit manufacturers' product data for specified materials including each type piping, each type valves, driers, moisture indicators, and strainers.
- D. Operation and Maintenance Data: Submit operation and maintenance data for equipment provided, in accordance with Section 01 78 23 - Operation and Maintenance Data.
- E. Welder's Qualifications: Submit Brazer's Certificate signed by the Contractor certifying that Brazer's comply with requirements of ASME, Boiler and Pressure Vessel Code, Section IX.
- F. Test Reports: Submit certified test reports for valves and field test results for installed products.

#### **1.07 SITE CONDITIONS**

- A. Examine surfaces on, or to, which products will be installed before the work of this Section begins. Provide surfaces capable of supporting the weight of such products, and acceptable for the installation of the products. Perform soldering only when the piping is dry and clean.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS, EQUIPMENT, AND ACCESSORIES**

- A. Refrigerant Piping:
  - 1. Provide seamless copper tubing conforming with ASTM B280 and ANSI B31.5, as applicable, except provide Class J for buried underground insulated piping as specified in Section 20 10 13 - Common Materials and Methods for Facility Services – Fire Suppression, Plumbing and HVAC. Class J piping may be used for all insulated piping. Use of factory pre-charged piping is permitted.
  - 2. Tubing shall be factory cleaned, ready for installation, and shall have ends capped to protect cleanliness of pipe interior until installed.
  - 3. Valve strainers, dryers, moisture indicators, sight glasses, and vibration eliminators shall be full line size.
- B. Joining Materials: Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).
- C. Valves:
  - 1. Design, manufacture, and test valves specifically for the service intended. Comply with applicable ARI requirements. Provide removable internal parts for inspection and replacement without applying heat and breaking pipe connections. Direction of flow shall be legible and permanently indicated on the valve body.
  - 2. Globe and angle refrigerant valves shall have either forged brass or bronze alloy bodies, be back-seating type, and shall have packed stem and seal cap. Valves 7/8 inch outside diameter and smaller shall be packless type having handwheels and bodies with brazing ends. Bonnets shall be replaceable while the valve is in place. Valves shall be rated for 450 psig maximum working pressure and 275 degrees F maximum operating temperature.
  - 3. Check Valves Smaller Than 7/8 inch: 500 psig maximum operating pressure, 300 degrees F maximum operating temperature; cast brass body, with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.
  - 4. Provide relief and safety refrigerant valves with forged brass bodies; nonferrous, corrosion-resistant internal working parts; and either female threaded or brazing connections.

5. Solenoid valves: Complete valve assembly shall be tested and shall be listed by a nationally recognized laboratory and shall be designed to conform to ARI 760. Solenoid valves shall be 250 degrees F temperature rated, 400 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, and 24 V ac, 60 Hz, normally closed holding coil.
- D. Fittings: Wrought-Copper Fittings, ANSI B16.22 and ANSI B16.26, as applicable, streamlined pattern.
- E. Strainers:
1. Provide single type strainer with brass body 500 psig maximum working pressure. Indicate direction of flow permanently on the body. Provide flange and bolt screen cover for strainers 1 inch and larger. Screen cover for strainers smaller than 1 inch shall be flanged and bolted or screwed.
  2. Provide strainer body of a size which will provide storage area for foreign material without contributing to excessive pressure drop. Free area of the screen shall be minimum five times the area of the strainer inlet pipe.
  3. Screen mesh size shall be not less than 80 for 1 inch diameter liquid refrigerant lines, and not less than 60 for other liquid refrigerant lines. Screen mesh size shall be not more than 40 for refrigerant suction lines.
  4. Reinforce strainer screens with eight or ten wire mesh screen. Strainers may be an integral part of the expansion valve. Braze strainer and screen joints with silver solder.
- F. Refrigerant Driers:
1. Provide solid desiccant type drier conforming to ARI 710. Driers 50 cubic inches and larger shall be cartridge refillable type, with a valved bypass of the same size as the liquid line.
  2. Provide drier body of brass, capable of holding the desiccant securely in place and distributing the liquid refrigerant evenly throughout the desiccant, and capable of withstanding a test pressure of 350 psi.
- G. Moisture Indicators: Moisture indicators shall contain material that shall indicate degree of moisture by color. Indicators shall be either brass, bronze, or heavily copper-plated steel. Locate indicating material under a bull's-eye. Design indicators to withstand a 350 psi test pressure.
- H. Sight Glasses: Provide double-port, see-through type sight glass having two bull's-eyes of nonferrous material. Design sight glass to withstand a 350 psi test pressure. Sight glass body shall be either forged brass or bronze, with flanged fittings as specified for piping.
- I. Expansion Valves: Provide bronze valves, suitable for silver-soldered joints, and of external equalizer design, conforming with ARI 750, as applicable. Provide valve capillary tubes of lengths required and a distributor with side connection for hot gas bypass line.

- J. Hot Gas Bypass Valve: Provide adjustable type, sized to provide capacity reduction beyond the last step of compressor unloading; and wrought copper fittings for solder and connections.
- K. Vibration Eliminators: Provide flexible bellows tube type vibration eliminators with seamless tin bronze or stainless steel core. Provide with the following features and services: high tensile bronze braid covering, solder connections, pressure tested, dehydrated, minimum 500 psig working pressure, UL-labeled, minimum 7 inches in length.

## **2.02 REFRIGERANT**

- A. Provide non chloro-fluro carbon refrigerant, except as otherwise indicated. All components exposed to refrigerant shall be compatible with refrigerant. Components shall be completely charged. Furnish additional charge if required for low ambient control.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install refrigerant piping in accordance with ASHRAE 15.
- B. Cut refrigerant piping accurately to measurements established at the site, and install without springing or forcing. Installed piping shall be sufficiently flexible to allow expansion and contraction caused by temperature fluctuation inherent in its operation.
- C. Do not conceal piping in walls and partitions, underground, or under a floor, except as indicated. Do not conceal pipe joints within the building. Run insulated pipe as indicated and as required, with sufficient clearance to permit application of insulation. Run piping as indicated, care shall be taken to avoid interference with other piping. Run piping plumb and straight.
- D. Refrigerant piping shall be joined by brazing. Free the inside of tubing and fittings from burrs and flux. Clean the parts to be jointed thoroughly with emery cloth. Heat to a temperature greater than the solder flow point, and keep heated until the solder has penetrated the full depth of the fitting and the extra flux has been expelled.
- E. Joints shall be air cooled, and flame marks and traces of flux shall be removed. During the brazing operation, protect the piping from forming an oxide film on the inside.
- F. Install refrigerant lines in a manner so that the velocity in the evaporator suction line will move the oil and gas to the compressor. Oils shall be automatically returned on halocarbon systems. If equipment location requires a vertical riser, provide riser of a size so that the oil will be lifted at minimum system loading and corresponding reduction of gas volume. Install a double riser if excess velocity and pressure drop would result from full system loading. Provide the larger riser with a trap, of minimum volume, formed by 90-degree and 45-degree ells. Arrange the small riser with inlet close to bottom of horizontal line, and connecting to top of upper horizontal line. Do not install valves in risers.
- G. Slope refrigerant piping as follows:

1. Install horizontal hot gas discharge piping with 1/2 inch per 10 feet downward slope away from the compressor.
  2. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
  3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
  4. Liquid lines may be installed level.
- H. Install refrigerant driers, sight glass liquid indicators, moisture indicators, and strainers in refrigerant piping if not furnished by the equipment manufacturer as part of the air-conditioning equipment. Install driers in liquid lines, with service valves and valved bypass line. Install driers 50 cubic inches and larger, vertically. Provide cover for removing cartridge at the bottom of the drier.
- I. Install moisture indicators in the liquid line downstream of the drier.
- J. Locate strainers near the equipment requiring protection. Install a strainer in the common refrigerant liquid supply to two or more thermal valves in parallel if each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainer body.
- K. Install refrigerant charging valve connection for each remote type refrigeration system, located on the reducing outlet of a full size tee in the liquid line, upstream from the refrigerant drier and liquid indicator sight glass.
- L. Install solenoid valves in horizontal lines, locate stems vertically, and indicate direction of flow on the valves. If not incorporated as integral part of the solenoid valve, install strainers upstream of the solenoid valve.

### **3.02 CLEANING**

- A. Before installation of copper tubing, clean the tubing and fittings using the following cleaning method and procedure:
1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
  2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
  3. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt or lint.
  4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

**3.03 TESTS**

- A. Test piping system under the observation of the Engineer until found to be leak free. Perform tests as follows:
1. Upon completion of factory-fabricated and field-refrigerant piping installation, test piping with either a halide torch or electronic-type leak detector. If leaks are detected during the warranty period, remove the entire refrigerant charge from the system, correct the leaks, recharge the system, and retest.
  2. After the system is found to be without leaks, perform the evacuation with a gage and a vacuum pump capable of pulling a vacuum not less than one mm Hg absolute. Perform system evacuation in accordance with either the triple-evacuation and blotter method or the equipment manufacturer's instructions. System leak testing, evacuation, dehydration, and charging with refrigerant shall conform to ANSI B31.5.
  3. Refrigerant piping system, including its safety and automatic control instruments, shall be started up and initially operated for not less than eight hours.
- B. Use testing instruments calibrated by a qualified laboratory in accordance with Section 01 45 00 - Quality Control.

**3.04 COMMISSIONING**

- A. Charge system using the following procedure:
1. Install core in filter dryer after leak test but before evacuation.
  2. Evacuate refrigerant system with vacuum pump; until temperature of 35 degrees F is indicated on vacuum dehydration indicator.
  3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
  4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
  5. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.
  6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.
- B. Provide training of the District's personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties in accordance with Section 01 79 00 - Demonstration and Training.

**END OF SECTION 23 23 00**